DIET AND DENTAL DECAY

By DR. JOSEF ESCHLER

If a large number of people were to be asked what kind of professional treatment they had most frequently undergone, the replies would undoubtedly show that our teeth require more attention than any other part of our body. Many people who do not go to see a doctor for years nevertheless go regularly to their dentist. Why is it that, of all the organs with which we have been equipped by Nature, our teeth are the ones to fail us most often?

An interesting reply to this question is given by Dr. Eschler, an outstanding German dental specialist who is at present in Tokyo for the purpose of research. He received his scientific training at the German Karl University in Prague as well as at numerous institutions and clinics. Incidentally, Dr. Eschler also played a leading part in the struggle of the Sudeten Germans for their inclusion into the German Reich. He was a political leader of the Sudeten German Party; in September 1938 he was condemned to be shot by the Czech military authorities but was freed by the Munich agreement. His scientific publications, numbering more than thirty, deal chiefly with bone histology and the maintenance of teeth.—K.M.

THE word "caries" means decay and is used in medicine for diseased conditions of bone and teeth in which these otherwise hard organs become soft and disintegrate.

The causes for this decay, however, are different in the case of bones and teeth. In the case of the former, caries is caused by cells which eat away the bone, so that the bone is replaced by a soft, cheesy tissue liable to inflammation. Dental caries arises from other causes. Here we do not find any body cells eating away the tooth; moreover, this is impossible since those parts of the teeth which are attacked by caries project freely into the oral cavity, and their exterior surfaces are formed not by cells but by cell-less, hard tissue: enamel. On the whole, the ideas of the old German scientist Miller are still valid, namely, that dental caries is caused by chemical-parasitical, essentially bacterial processes.

The hard-tissue substances of the teeth, the enamel as well as the dentine, gradually soften through the effect of acids and bacteria. In their place there remains a soft mass consisting of bacteria, food particles, and the remaining softened enamel and dentine substances—which is then slowly washed away. Finally, when the crown of the tooth has thus decayed and the caries has started to affect the root, the whole tooth is lost.

A DISEASE OF CIVILIZATION

Dental caries is caused by many factors, some of which play a big role and some a lesser one. Faulty diet has long been blamed as being one of the main reasons for the tremendous spread of dental decay which, during the last few centuries, has assumed the proportions of a world-wide disease.

The study of the teeth and skulls of our ancestors, especially those made by the German scientists Euler, Greth, etc., as well as various experimental studies, have greatly contributed toward faulty diet nowadays being regarded as a very important if not the most important factor for this disease. Indeed, in view of the good condition of the teeth of ancient man and the rare occurrence of dental caries, Euler considers the changed diet caused by the cultural and technical developments during the last centuries as the chief factor.

The Norwegian Toverud and others have offered many examples which prove that not until the last few decades, simultaneously with the construction of roads, the improvement of communica-

tions, and the progress of engineering, did dental caries appear, together with civilization, in certain remote localities.

For civilization has changed man's diet. The modern cooking stove and baking oven, finer grinding of wheat, polishing of rice, baking of white bread and cakes, etc., made their triumphal entry. All these things which are generally considered to mean great progress represent, however, a certain drawback, at least with regard to the health of human teeth. Teeth were created for chewing; they are meant to be used to masticate food. But what did the above-mentioned progress lead to?

The original primitive fireplace gradually developed into the modern gas or electric stove or large coal range. All food must now be cooked until it is soft; otherwise it is unpalatable to modern man. It need hardly be emphasized that long cooking destroys the vitamins and minerals. Of course, we do not mean to imply that the cooking stove should be done away with. But we do recommend the sparing use of the flame, which otherwise destroys the most valuable substances. Many kinds of vegetable and fruit can be eaten raw; others can be made palatable by steeping them in boiling water or parboiling them.

WHITE BREAD: ENEMY NO. I

Another technical advance is represented by the mills, baking ovens, and bakeries. The early stone mortars developed into mills equipped with intricate machinery, with the express purpose of removing as much bran—and with it vitamins and minerals—as possible from the grain. Of course, it is easier to make cakes and white bread, preferred by so many people, from such white flour than from the darker flour that has not been ground so fine. And bran is considered just about good enough for fodder. Although bread becomes darker through a larger bran content, it also becomes more nourishing and—what is more important—contains substances essential to the building up of the human body. It is significant that the German authorities have in recent years prohibited the fine grinding of flour.

The mill was followed by the baker and his oven to make the nice white flour even more palatable. But by this process additional essential body-building substances, vitamins and minerals, which even the fine flour still contained, were lost.

We know for certain now that all these processes of modern food preparation destroy substances which are essential to the forming of hard teeth. As the hardness is the result of good calcification, one might assume that the plentiful addition of calcium salts in various forms such as Kalzana, Calcipot, Calcium Sandoz, etc., to the diet should suffice for the formation of hard, well-calcified teeth. However, in order for the human body to benefit properly from these calcium salts, other substances are needed. On the other hand, the age at which calcium and such other substances are given plays an important part.

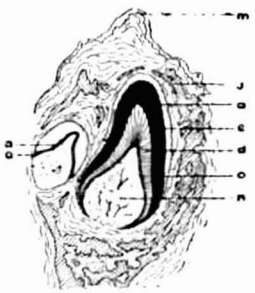

FIG. 1 Development of the teeth: milk tooth (right) and permanent tooth (left, behind the milk tooth)
m — mucous membrane of the mouth
j — jawbone
a — ameloblasts (cells which secrete the enamel)
e — enamel
o — odontoblasts (cells which secrete the dentine)
d — dentine
n — nerve

FILLINGS DO NOT CURE

As can be seen from FIG. 1, the teeth are formed in the jaw. They are formed here by cells; the enamel, for instance, the hardest and outermost layer of the crown by the ameloblasts (enamel-secreting cells) which, however, perish just before the teeth break through the gums. Thus enamel can no longer be produced once the crown has appeared in the oral cavity, and hence can never be replaced after having been destroyed by caries. The dentine under the enamel also cannot be

replaced after it has been destroyed by caries. Thus a hole in the enamel and in the dentine will always remain a hole. If it is not treated, it will become larger; but in no circumstances will it ever become smaller, much less be filled in by enamel and dentine, in contrast to the healing of wounds, which latter takes place by new tissue being formed and the defect being filled in by this new tissue. Hence we are forced to fill in defects in the tooth by artificial means such as fillings, inlays, crowns, etc., in order to prevent the caries from spreading.

But can this be called curing? For first of all we are even obliged to enlarge the hole in order to provide a durable foundation for the filling or the crown. Then we stop up the hole with a foreign substance that is often harmful to the tissues, exerting a very unfavorable influence on the cell activity in the nerve of the tooth and sometimes entailing the destruction of the cells. Indeed, we are not even able to remove a simple inflammation of the nerve—an inflammation that can be cured everywhere else in the body while the tissue is maintained or replaced—without removing the nerve itself and replacing it by an artificial disinfecting substance. Sometimes the most minute damage by substances which apparently do not harm the tissues may still cause serious physical defects after a number of years. We need only mention the focal infection caused by nerve deadening.

What, after all, is a filling or a crown, however skillfully made, but a diminutive prosthesis, with all its advantages and disadvantages? The purpose of this short digression is only to emphasize our further remarks on the significance of a correct diet for the maintenance of sound teeth.

WHEN TO BEGIN

How can dental caries be prevented or at least reduced to a minimum? Since it is a general belief that, the harder a tooth is, the greater is its resistance, people hope to achieve such hard, caries-resistant teeth by feeding children sufficient calcium. How often do we hear from mothers that their children have been fed calcium since birth or since they were weaned. And when we ask what quantities of calcium have been fed every day, we are told incredible amounts, as if fifty per cent of the human body were composed of calcium. In most cases it is added to the diet in its purest form, a mixture of calcium carbonate and phosphate of lime. This is done in the assumption that this pure calcium is used by the body entirely to build up bones and teeth. Yet at the age of five or six the child sometimes has not a single sound tooth in its mouth. This fact, in turn, is often the cause of increased doses of calcium, and the mothers are surprised that the teeth continue to get worse in spite of this. Thus the reason is not a lack of calcium alone, but of other substances which are able to deposit the calcium at those places of the body—especially the bones and teeth—which require it. The fact that the feeding of calcium is often not begun until some considerable time after birth is an added reason why so many children suffer from caries.

Knowing how and where the teeth are formed, we must make every effort at the first indication of the forming of teeth, not only to prevent a lack of calcium in those cells, but also to provide the necessary means that allow the body to absorb the available calcium. FIG. 2 shows that the first indications of the calcification of the milk incisor teeth appear in about the sixth month of pregnancy. During the eighth month of pregnancy, the crowns of the milk molars also begin to calcify. Thus it is necessary to begin at least at this period of the child's development to provide sufficient calcium to enable the teeth-forming cells to pass it on to the hard-tissue substances of the teeth. But it is advisable to start the feeding of calcium even earlier.

CALCIUM IS NOT ENOUGH

However, as we have said before, this calcium alone is not enough to build up

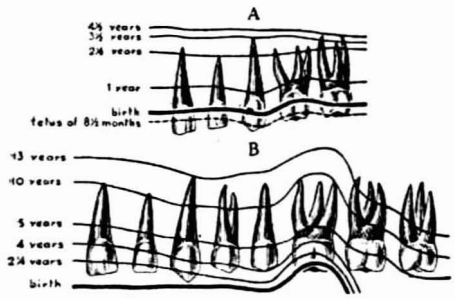

FIG. 2 Calcification of the teeth
(A) of the milk teeth
(B) of the permanent teeth

hard bones and hard teeth. We can give a child as much calcium as we like, and yet that child will develop serious dental caries if the other factors are lacking. For, although the calcium is absorbed by the process of digestion, it is not made use of for building-up purposes but passed out in its original quantity if there is a lack of vitamins. The best example of this is rickets, which we can neither prevent nor cure by the feeding of calcium. And yet it is characterized by calcium deficiency of the bones. Experiments have proved that, together with the calcium, sufficient quantities of vitamins must be given in order to enable the cells in question to absorb the calcium. Indeed, the vitamins alone are often enough, as long as the ordinary diet contains sufficient quantities of calcium.

Thus the process of the calcification of the teeth consists, not in a simple calcification, but in a complicated process often called mineralization. The hard-tissue substances of the teeth are at first secreted as soft tissues, which then begin to mineralize. In the course of this mineralizing, certain changes take place in the tissues, changes which make it impossible for us to assume a simple depositing of calcium. Thus we must definitely begin to add calcium and vitamins to the diet as soon as the cells begin to secrete the hard-tissue substances. The forming of the enamel, for instance, is not completed until shortly before the tooth breaks through. The enamel forms the outermost covering of the tooth and is supposed to protect the tooth from caries throughout life. A hard enamel, produced by the simultaneous feeding of calcium and vitamins, thus represents at least a certain guarantee for the maintenance of sound teeth.

BIRTH AND ITS EFFECT

The most threatened tooth, the one that most frequently suffers from caries, is the first permanent molar, which appears at the age of five or six. It adjoins the milk teeth, and for that reason a caries of the milk teeth often causes contact caries of the permanent molar. If only because of the possibility of contact caries, decaying milk teeth should not be left without treatment.

However, in our opinion there is an added factor, not to be underestimated, which is responsible for the pronounced tendency toward caries of the first permanent molar. FIG. 2 shows that the milk molars and the first permanent molar are at the stage of strongest development at the time of birth. Since birth means a tremendous change for the child in its nourishment—while the child obtained its nourishment in prepared form from its mother up to the time of birth, it must now suddenly rely upon itself and extract the various substances from its food—even a small deficiency of the substances needed for the calcification of bones and teeth will make itself felt especially in the above-mentioned three teeth. The fact that the food substances are not fully made use of by the child can be seen from the loss of weight that always takes place in the first two weeks of life. Thus for this reason, too, it is absolutely necessary for the mother to take sufficient quantities of vitamins and calcium before birth so as to provide the child with a certain reserve for its first few weeks of life.

The more the child's food consists of substances which easily produce hyperacidity of the blood, the more calcium and vitamins should be given. The chief of these substances are carbohydrates and cereals rich in carbohydrates, such as corn, oatmeal, and rice. Thus when babies are fed cornflour, porridge,

and rice, calcium and vitamins should be added to the diet to provide a certain balance, i.e., to provide the blood with sufficient substances which can be mobilized to prevent the formation of acids.

WHICH VITAMINS?

Let us say a few words as to which is the most important vitamin for the formation of so-called hard teeth, and which food items contain the necessary vitamins and calcium.

The formation of the teeth is perhaps the best example of the necessity of almost all the vitamins. It is a well-known fact that an infant cannot be brought up, without falling ill, if one or the other vitamin is lacking. For the absorption of calcium and for the strong mineralization of the enamel, Vitamin D is the most important. But closely bound up with it is Vitamin A, which is needed for the best possible absorption of calcium by means of Vitamin D. Both these vitamins are contained together in natural fish-liver oil. Next in importance is Vitamin C, which is needed especially for the calcification of the dentine. The B vitamins, on the other hand, are of minor importance in the formation of the teeth. Moreover, they are contained in almost every item of diet.

Vitamin D is probably the rarest of all, since it is to be found only in butter, milk, egg yolk, mushrooms, and fish-liver oil. Sometimes it is also found in dark-hued fruit. Vitamin A is plentiful in egg yolk, milk, butter, and fish-liver oil. Nor must vegetables be forgotten, which contain an abundance of Vitamins A and C. Raw egg yolk is one of the most important carriers of vitamins. Vitamin C is contained in large quantities in almost all vegetables and fruit, especially in lemons, parsley, oranges, lettuce, radishes, all kinds of berries, and raw potatoes.

The calcium content of the various foodstuffs differs greatly according to region. Among those richest in calcium are cheese, milk, lemons, oranges, nuts, and lettuce. Nevertheless, it is always advisable to add small quantities of calcium preparations even to a diet consisting of the above-mentioned items.

DOGS AND SUGAR

Quite often the feeding of sugar is regarded as a cause for dental caries during the development of the teeth. Although experiments on animals cannot always be applied to humans, they still permit certain comparisons. Japanese scientists have been able to produce advanced dental caries in dogs by adding small quantities of sugar to their diet. The German scientist Harndt, on the other hand, was able in his counter-experiments to show, if not the opposite, at least that the addition of sugar to the diet is of no important influence on the development of dental caries. All the puppies of these sugar-fed parents had normal teeth, even when they continued to be fed with sugar long after birth.

In our opinion the cause for these contrasting results is to be found elsewhere, at any rate not in the fact that the feeding of sugar alone results in a reduced mineralization of the teeth. For the other influences of environment which affected the dogs in both cases were entirely different. Above all, the remaining diet differed entirely. While the dogs in the German experiments were fed veal bones in addition to their sugar, the Japanese dogs were fed with a mush of rice containing a little vegetable and cut-up meat. This brings us to another important point of diet and its significance for dental caries.

DANGEROUS CREVICES

The veal bones gave the dogs an opportunity to masticate properly; at the same time they provided the necessary calcium and vitamins. In the case of the Japanese dogs, these items were missing. Moreover, a mush diet is one of the factors causing caries, especially when the mush consists of carbohydrates, as is the case with rice mush. Mush obviates mastication. Furthermore, particles of the mush very easily remain at certain places in the teeth, where the activity of the ever-present bacteria cause them to

decay. Especially in the case of human teeth there are numerous such places predisposed to caries. If, on the other hand, we are forced to chew hard foods, these places are automatically cleansed in the course of mastication.

The places most predisposed to caries are fine crevices on the chewing surface, the surfaces where the teeth adjoin, and the places just above the gum. Here soft particles are deposited and remain; they form a fertile soil for bacteria. The acids thus formed, together with the activity of the bacteria, then destroy the enamel and finally attack the dentine. The energetic chewing necessitated by hard foods cleanses these places and removes such remaining food particles.

All this goes to show that small additions of sugar during the development of the teeth, i.e., up to the age of twelve, have no harmful effect on the degree of calcification and the hardness of the teeth as long as the main diet contains sufficient vitamins and calcium and is otherwise healthy. A local effect of sugar on the teeth does not take place until they have come through, especially, as is usually the case, when the sugar is added to a mush diet or is taken in the form of soft confectionery, which, although satisfying the appetite, lacks calcium and vitamins. Sugar forms lactic acid, which, in conjunction with bacteria, decalcifies the enamel and dentine and causes caries. To this must be added that mushy food and soft bread and cakes require no mastication; instead of the surfaces of the teeth being cleansed by chewing, food particles are left behind, especially such food particles as form a favorable soil for bacteria. Incidentally, instead of sugar it is better to use honey for sweetening, as it contains vitamins and because it produces formic acid, which has a germicidal action.

THE IMPORTANCE OF CHEWING

Thus, in our efforts to prevent dental decay, we must first emphasize diet factors which are especially important during the development of the teeth. The cells which build up enamel and dentine must receive sufficient calcium and vitamins to enable them to form hard, well-calcified enamel and hard, faultlessly calcified dentine. And secondly, there are the exterior influences which are responsible for the development of dental caries. Among these we have mentioned mushy food rich in carbohydrates for infants, and cakes and confectionery for older children and grown-ups. In Germany as well as in other countries, school dental care has produced good results with the morning snack provided for the children. The children eat their snack together, and it consists mainly of hard brown bread, butter or vitaminized margarine, milk, and fruit. This common meal has several purposes. The hard bread is intended to force the children to use their teeth properly. The food cannot be swallowed as can mush, soup, or soft bread, but must be properly chewed. The jaws are strengthened; in this way, a kind of morning gymnastics of the masticating and facial muscles is achieved which has a beneficial effect on the position of the teeth and the shape of the jaw. At the same time the teeth are cleansed better than with a brush, or rather the food particles have no chance to be deposited at the caries-disposed spots. Moreover, the prolonged, thorough chewing stimulates the saliva; remaining food particles are washed away, the well-masticated food surrounded with plenty of saliva and thus the carbohydrate-splitting effect of the saliva ferments exploited to the utmost. Well chewed is half digested! In addition, brown bread still contains sufficient vitamins and, above all, the important minerals. The fact that the children eat together should also have a favorable effect on children who are slow at eating and chewing.

Of course, the effect of mechanical cleansing provided by the hard brown bread can also be produced by any other hard food item. Among them, those are the most preferable which also contain vitamins, such as apples (eaten raw with the peel), raw carrots, kohlrabi, rusks and similar hard bakery products (such

as the Japanese *sembe*) made of coarse flour or cracked wheat.

THE DENTIST NEEDS YOUR HELP

Thus diet has throughout life, indeed, even long before birth, an influence, often still underestimated, on the hardness of the teeth and their resistance against caries. Not only the type of food or the substances added to the diet are important, but also the preparing and the consistency. It is not enough to pay attention to one factor only. If a child, though stuffed with calcium preparations and vitamins, is fed a lot of cakes and sweets instead of at least some hard foods that have not been deprived of their most important substances, its teeth will always be threatened by caries.

So we see that it is not within the power of the dentist to exterminate caries. All his efforts at maintaining the health of the teeth are in vain unless every single individual does his share. In the whole wide field of public health there are probably few similar examples to show how, by following simple rules of diet and living, a person may contribute to such an extent toward his own health, the health of his children, and thus of his nation.

SAILORS IN CONVOYS

By ALBERTO Da CRUZ

Every day we read in the newspapers about the grim struggle taking place between the Allied merchant fleets and the Axis U-boats. Many are the accounts of this struggle seen through the eyes of the pursuer—the U-boat. But we hardly know anything about how this struggle looks through the eyes of the crews of the pursued Allied freighters. In the following article we present an account of this duel as it appears to them. How the material for this article was collected is told by the author, a young Portuguese journalist in Shanghai.—K.M.

WHEN the war broke out in the Pacific almost two years ago, it performed a bloodless operation in segregating for the duration a few hundred Scandinavian sailors from the sea. The war cut a swathe through their ranks, and to many of them it meant waking up one Monday morning and realizing that Shanghai was to be their enforced home for as long as hostilities might last. A few accepted this uncertain period of idleness as a blessing to restore them from war wrecks to a sounder balance of mind, but many inwardly resented being deprived of their natural element, the sea.

I am staying in a place where a number of these sailors have made their home. It has not been hard to get to know them well, as sailors are the friendliest people alive, if you understand their moods and leave well enough alone. They represent most of the northern European countries whose young men have taken to the sea, and almost all have seen war service in one way or another before being stranded so unexpectedly in Shanghai.

They are all neutral merchant sailors who are not connected with the Allied navies. From the way they express their dislike for navies in general you feel that there is too much rivalry between them to make mutual fellowship possible. Even the long partnership of danger that followed the outbreak of the war in Europe has not brought about a relaxing of this somewhat instinctive dislike. These merchant sailors appear to have a notion that too much credit is given to the navy when they, too, have met with considerable hazards in the course of their war-time duty.

They are a bunch of hardy fellows who have been through it all. The interval between the outbreak of the European